

REMARKS

Claims 1-35 are pending in the present application and stand rejected on various grounds. Claims 1, 27, 32 and 33 are amended herein. The amendments are fully supported by the specification and claims as originally filed and do not add new matter. Applicants have also added Claims 36-38 to better protect what Applicants regard as the invention. Support for these claims can be found in the original specification. *See, e.g.*, Examples 1 and 3.

Claim Rejections Under 35 U.S.C. §103

The Examiner has maintained the rejection of claims 1-27 under 35 U.S.C. §103(a) as unpatentable over DiMeo Jr. et al. (U.S. Patent No. 5,972,430) in view of Kirlin et al. (U.S. Patent No. 5,453,494). Claims 25 and 26 were further rejected over DiMeo and Kirlin in view of Maiti et al. (U.S. Patent No. 6,020,024). In particular, the Examiner states that DiMeo discloses a CVD method for forming multi-component oxide layers.

In response to Applicants' prior argument that DiMeo does not teach ALE, the Examiner indicated that the CVD method of DiMeo is described as an equivalent variant to ALE. Importantly, the examiner noted that the features of ALE that distinguish the CVD method of DiMeo were not recited in the claims. Applicants respectfully submit that the term "atomic layer epitaxy" (ALE) is well known in the art to refer to a process that involves alternating, self-limiting surface reactions. Thus, one of skill in the art would recognize that the methods of Claims 1 and 27 are inherently self-limiting. Nevertheless, to expedite prosecution Applicants have amended independent Claims 1 and 27 to explicitly recite the alternating and self-limiting nature of the claimed ALE processes. New claims 36-39 also recite these distinguishing features. As DiMeo's CVD method does not teach a method comprising alternating, self-limiting surface reactions, Applicants respectfully submit that the rejections under 35 U.S.C. §103(a) should be withdrawn.

Applicants disagree with the Examiner's characterization of DiMeo as teaching that ALE is an "equivalent variant" to or "a form of" CVD. DiMeo merely discloses in the Background section that "(CVD) methods and *related* epitaxial deposition methods, such as but not limited to atomic layer epitaxial (ALE) deposition methods, are in turn also presently *of substantial interest.*" '430 Col. 1, ll. 44-50 (*emphasis added*). Applicants respectfully submit that a mere

background statement disclosing that CVD and ALE are related and are presently of interest, with nothing more, does not teach or suggest the equivalence of CVD and ALE or the applicability of a CVD method to ALE. Rather, the skilled artisan will recognize that although they are related, chemical vapor deposition (CVD) and atomic layer epitaxy (ALE) are distinct deposition processes which require their own specific process conditions. Importantly, because of the different nature of ALE and CVD, the process conditions are not interchangeable.

Differences in Applicants' ALE method and DiMeo's CVD method are apparent in the level of control of the composition of the deposited multi-component layer. While Applicants recite self-limiting surface reactions in an ALE method, DiMeo discloses that the composition of the multi-component film is controlled by selecting a suitable ratio of the precursors (i.e., barium, strontium and titanium precursors) in the reactant source material mixture. *See*, '430, col. 12, ll. 1-8 and '062 Application p. 9, ll. 6-8. DiMeo's simultaneous injection of multiple reactants results in competing reactions on the substrates surface, which negatively affects layer composition uniformity. The composition of DiMeo's multi-component precursors layer is also subject to the physical circumstances on the substrate, such as temperature and ambient pressure variations. Further, the oxidation phase in the DiMeo process is difficult to control, since the oxidation rates of the different components in the multi-component layer inevitably are different. In view of the forgoing, the composition of DiMeo's multi-component layer is both difficult to control and predict. As a result, DiMeo's traditional CVD process yields a multi-component layer having a composition which is much less uniform across the substrate surface than the composition uniformity made possible by Applicants' ALE method.

DiMeo's CVD method does not teach or suggest an ALE process as claimed by Applicants. Accordingly, Applicants submit that the rejections under §103 should be withdrawn.

#### Claim Rejections Under 35 U.S.C. §112

Claims 28-35 stand rejected under 35 U.S.C. §112, second paragraph, as being incomplete for omitting essential steps. In particular, the Examiner indicated that the step of oxidant introduction between strontium and titanium metal precursor introduction is omitted.

Claim 28 recites pulsing a second reactant comprising oxygen into the reactor during the growth cycle. However, to clarify the claimed method Applicants have amended Claim 28 to

indicate that the claimed pulse of reactant comprising oxygen is provided between pulses of the first reactant and the third reactant.

Applicants would like to point out that, because ALE involves a continuous string of cycles, the pulse of second reactant can be provided after the pulse of the first reactant and prior to the pulse of the third reactant, or after the pulse of the third reactant and prior to the pulse of the first reactant. These alternative pulsing orders are recited in Claims 32 and 33, which have been amended to clarify when the pulsing occurs and that there is a purge between pulses.

As the method of Claims 28, 32 and 33 are believed to be clear, Applicants request withdrawal of the rejection under 35 U.S.C. §112, second paragraph.

The Examiner also rejected Claims 31, 34 and 35 under 35 U.S.C. §112, first paragraph, stating that the specification only describes the deposition of Sr-O and Ti-O alternating layers and does not support the addition of barium to the layers.

Applicants respectfully submit that explicit support for the addition of Ba to the layers is provided in the specification at page 7, lines 6-11, page 8, lines 23-25 and in Example 3 (page 11, lines 23-28), which describes the growth of BaTiO<sub>3</sub> films. In view of this disclosure, Applicants request withdrawal of the rejection of Claims 31, 34 and 35 under §112, first paragraph.

Appl. No. : 9/787,062  
Filed : June 28, 2001

CONCLUSIONS

In view of the present amendments and arguments, Applicants submit that the pending claims are in condition for allowance. If some issue remains that the Examiner believes can be addressed by Examiner's Amendment, he is cordially invited to telephone the undersigned for authorization.

Respectfully submitted,

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Dated: May 29, 2003

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